Project 1A
Concentration and Effects of Selenium in Shorebirds

SUBCONTRACT WITH:	Weber State University
PRINCIPAL INVESTIGATOR:	Dr. John Cavitt
CONTRACT VALUE:	$62,210
SCHEDULE:	April 1, 2006 through November 1, 2006 (elapsed time: 8 months)

Project Objective

The project objectives are generally to:

1. Determine ambient selenium concentrations in water, sediment, brine shrimp, brine flies, and unidentified food items in nesting shorebird foraging areas, bird eggs, bird blood, and livers;
2. Determine stomach contents of nesting birds; and
3. Determine if selenium concentrations effect reproductive success of American avocets and black-necked stilts at the Great Salt Lake.

Please see Data Quality Objectives for Project 1A for further detail.

General Assumptions

1. All work completed as part of this scope of work will follow UDWQ's Quality Assurance Plan protocol. Samples will be shipped to the laboratory selected by UDWQ following required protocol. Cost of laboratory analysis is not included in this scope of work.
2. All necessary clearances/permits to complete the work specified herein will be acquired prior to and maintained for the length of the work. All access will be properly coordinated and permission obtained.
3. Safety is of the essence. Health & safety protocol will be identified prior to beginning field work and followed.

Scope of Work

Task 1. Preparation of Workplan, Budget Estimates, and Data Quality Objectives

Prior to executing Project 1A, a workplan and the associated components (i.e., budget, required SOPs/protocols, etc.) as well as Data Quality Objectives will be prepared and

then reviewed by the Great Salt Lake (GSL) Science Panel, Utah Division of Environmental Quality, technical advisors, and GSL Steering Committee. This task also includes participation in study team meetings, conference calls, and other tasks on an as-needed basis.

Deliverables

1. Draft and Final Data Quality Objectives for Project 1A (completed by 4/28/2006).
2. Workplan including scope of work, projects costs, project schedule, health & safety plan, protocols for (1) collecting water/sediment samples, (2) collecting, handling, and shipping samples (completed by 4/28/2006).

Task 2 – Survey GSL for American Avocet (AMAV) and Black-necked Stilt (BNST) Nesting Areas

Four study areas have been identified at GSL (see Figure 1). These areas will be surveyed for nesting aggregations and include:

- West Carrington Bay -- This area has almost no freshwater input and may be influenced by the deep brine layer that forms and depletes at different times than the main body of the lake.
- The South Shore and Eardley Spit -- These areas have very little fresh water inflow.
- The Southeast Corner of the GSL -- This area experiences inflows from the Goggin Drain and Lee Creek, both of which are primarily freshwater. The C-6 ditch flows in from Kennecott and a pipeline of Kennecott wastewater is also discharged into the main body of the lake near this area.
- The east side of Ogden Bay -- This area is influenced by freshwater from all of the main inflows to the lake.

These sites will be surveyed by aerial transect beginning late April. Coordinates will be recorded of nesting aggregations to facilitate the remaining tasks. It is assumed that this task will require no more than 16 hours of flight time.

Deliverables

- Technical memorandum with maps indicating coordinates and description of nesting locations.

Schedule

This task will be completed by July 31, 2006.

Task 3 – Determine Nesting Status and Identify Foraging Sites

Once aggregations have been identified, they will be visited to determine the stage of breeding and to identify foraging locations. Breeding stage will be determined by observing behavior and by floating eggs (if present) from a sample of nests to estimate stage of incubation. Floating schedules developed by WSU for both AMAV and BNST will be used for stage estimates. Most AMAV and BNST forage in close proximity to their nests. However, to ensure accurate data we will use behavioral observations to

locate foraging sites. A random sample of nesting adults will be identified and followed with spotting scopes to identify foraging locations.

Deliverables

- Technical memorandum - combined with deliverables from Task 2 above.
- Maps indicating nesting and foraging locations
- Summary of behavioral observations of foraging sites and their relation to the nesting aggregations described in Task 1 above.
- Table indicating range of nest initiation dates for each study location

Schedule

This task will be completed by July 31, 2006.

Task 4 – Collect Dietary Information for Both AMAV and BNST

Dietary information will be obtained by direct examination of gut contents. Five adult males of each species will be collected at each site at the beginning of the nesting season (USFWS Permit #MB043593-0; UT Division of Wildlife Resources COR# 1COLL7037). Collections will be made as early in the season as possible to minimize disturbance of incubating birds. AMAV and BNST will be collected after individuals have been observed feeding for >15min. This will ensure that food items are present within the esophagus. Material collected from the ventriculus is less reliable as an indicator of diet since easily digested items are quickly passed to the intestines whereas hard material can be retained for weeks.

Immediately following collection, esophageal, proventricular, and ventricular contents will be removed, separated, and placed in individual containers with 80% ethanol. In addition the mouth (pharynx) will be rinsed with 80% ethanol and wash collected. Invertebrates will be identified to family or order, counted, and measured. The volume composition of samples (as percent) will also be determined.

Deliverables

- Technical memorandum providing the location, number, and species of birds collected and determination of the food material that was collected from their pharynx, esophagus, proventriculus and ventriculus.

Schedule

This task will be completed by July 31, 2006. Technical memorandum will be compiled and delivered by November 1, 2006.

Task 5 – Collect Food and Water Samples from the Foraging Areas

Foraging areas will be delineated from the point birds were first detected foraging to the point where they are collected. A transect will be established within that area and sediment (including surficial sediment) and water samples collected and depths recorded at five random points along its length. Sediment will be composited into a single sample for each feeding transect. During the 15-min. feeding observation, we will

record the amount of time each bird spends within each foraging microhabitat (e.g., exposed mudflat, shallow water, moderate water, deep water). After each shorebird observation/collection, invertebrates will be collected from the mudflat, benthos, and water column within each foraging area. Invertebrate food items (brine fly adults and/or larvae or pupae and brine shrimp, depending on what the birds are eating) will be collected opportunistically in the general area of each foraging area. If available, three samples of each species and life stage (i.e., larvae, pupae or adult of brine flies) will be collected at each area, with sufficient biomass for analysis (target 5 grams) and additional biomass when that is feasible. However, the numbers and types of invertebrate samples will be based on what the birds are eating.

Assumptions

1. The methods described above will be completed at all 4 nesting areas.
2. Protocol for collecting water, sediment, and food samples will be coordinated with other researchers.
3. The following is a summary of the expected number of samples to be collected:

Water	8
Sediment	8
Brine flies	24 (up to 36 if all life stages are important dietary components)
Brine shrimp	12

Deliverables

- Technical memorandum detailing the locations of samples (including foraging microhabitat), water depth at foraging sites, identification of invertebrates collected, and water sampled.

Schedule

This task will be completed by July 31, 2006. Technical memorandum will be compiled and delivered by November 1, 2006.

Task 6 – Collect Eggs from Nesting AMAV and BNST

Eggs will be collected from both AMAV and BNST nests. UTM's will be recorded at all nests where eggs are collected. A single egg will be collected from each of 10 nests for each species at each location upon discovery of the nest. After the clutches are completed, an additional 10 eggs containing late-stage embryos (based on egg flotation) per species will be collected from at each site. Established protocols for collecting eggs for contaminant analysis will be followed. Each embryo will be checked for stage of development, developmental abnormalities including a determination of the embryo's position in the egg. Egg contents (including the embryos) will then be placed in a marked chemically-cleaned container and preserved frozen for later analysis. Up to 10 eggs of each species from each site will be delivered to laboratories contracted to analyze for total selenium; eggs with late-stage embryos will be selected preferentially, if available. The remaining samples will be stored for possible later analysis.

Deliverable

- Technical memorandum detailing the locations of eggs collected and egg collection data sheets.

Schedule

This task will be completed by July 31, 2006.

Task 7 – Determine Hatching Success and Collection of Deformed Young

Nests of both AMAV and BNST will be located within each site and monitored to provide data on breeding productivity such as hatching success and nesting success using established methods (such as Mayfield methods). Nest searching and monitoring protocols follow the methods established by my research laboratory. Near the time of hatching, nests will be checked to collect any fail-to-hatch eggs. Hatching and nesting success information will provide critical information on population health as well as provide information on the effects of water quality on breeding success and productivity.

Deliverables

- Technical memorandum summarizing hatching success, nesting success, malpositions, and deformities identified within each site.

Schedule

This task will be completed by July 31, 2006. Technical memorandum will be compiled and delivered by November 1, 2006.

Task 8 – Determine Selenium Concentration of Collected Samples

Samples (blood, livers) from all collected adults, up to 10 deformed young of each species from each location, up to 10 randomly collected eggs of each species from each area, and up to 10 randomly collected fail-to-hatch eggs of each species in each area will be sent for analysis of selenium and remainders of the eggs will be archived for possible analyses of metal concentrations. Additional biota samples (e.g., brine flies and brine shrimp) collected from the foraging areas will be stored frozen for possible later analysis for heavy metals.

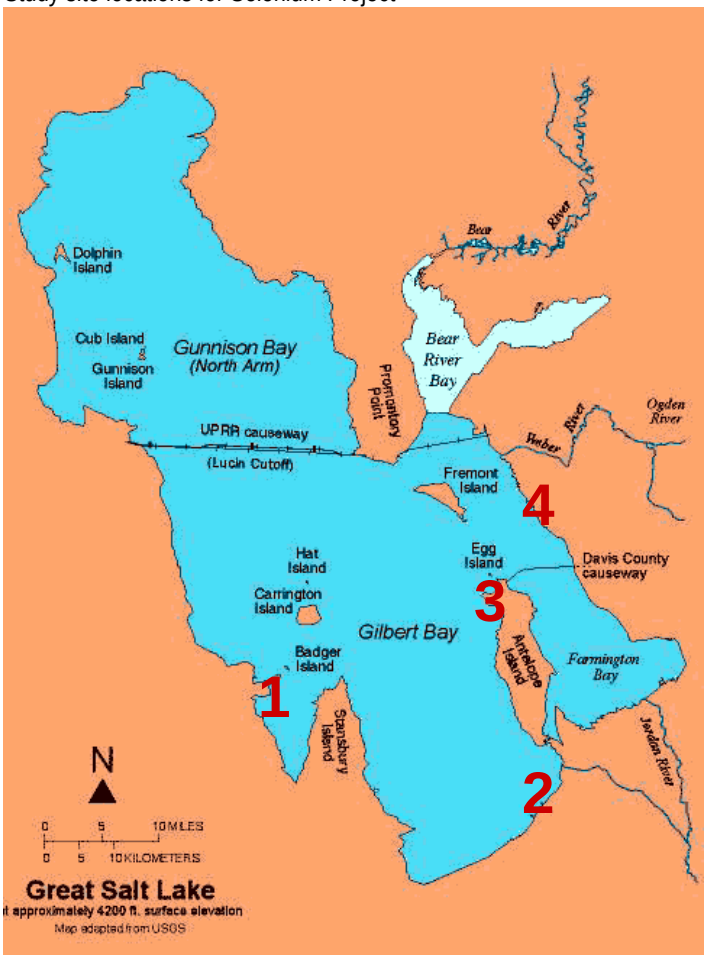
Deliverable

- Laboratory chain-of-custody forms (COCs) and list of stored samples
- 2006 Interim Final Report

Schedule

The laboratory COCs and list of stored samples will be completed by October 1, 2006. The 2006 Interim Final Report will be completed by November 1, 2006.

Figure 1.
Study site locations for Selenium Project



1. West Carrington Bay
2. Southeast Shore
3. Antelope Island
4. Ogden Bay East